Boosting Bread's Value

Emulsifiers are key to baked goods' texture and shelf life. **Lecithin and soybread, in particular, are profiled. Ingredients from fat, oil and emulsifier suppliers are showcased.**

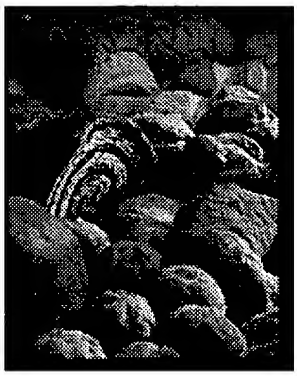
Laura A. Brandt
Technical Field Editor

Fats, oils and emulsifiers play an important role in baked goods. For example, in soy-based breads, soy flour absorbs water to form a gel, making the loaves quite dense. Emulsifiers help open up the bread texture for less-dense loaves, with greater volume. In addition, emulsifiers improve dough handling and help extend bread's shelf life.

Emulsifiers

By using a surfactant, such as an emulsifier, one can create an emulsion of two or more incompatible substances. A typical emulsion is a dispersion of small droplets of one immiscible liquid within another. Emulsifiers keep the droplets from coalescing. These ingredients not only offer emulsification, but also starch complexing, protein strengthening and aeration in baked goods.

Emulsifiers are used in bread to extend shelf life by slowing down the staling process. Bread tastes and feels stale when it starts to taste like cardboard, and feels dry and hard. In the laboratory, staleness can be measured by the crumb's resistance to compression, with an instrument such as the Instron Universal Testing Machine.

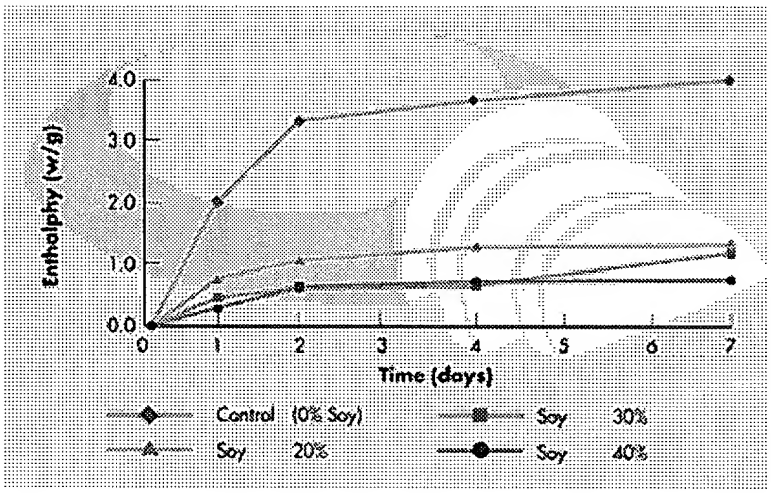


Emulsifiers used in breads include mono- and di-glycerides, various forms of lecithin, diacetyl tartrate ester of monoglyceride (DATEM), and sodium stearoyl lactylate (SSL). Most bakeries use a blend of these functional ingredients.

According to research studies, staling is not related to moisture loss from bread. While days old bread gives a drier mouthfeel, it has the same moisture level as fresh bread.

Rather than producing an initially softer crumb, as previously believed, emulsifiers interfere with the recrystallization (or retrogradation) of amylose, which retards the firming rate. The fatty acid-end of emulsifiers forms a complex with gelatinized starch to slow down starch recrystallization and the staling process in bread. (See chart on page 42.)

Emulsifiers used in breads include mono- and di-glycerides, various forms of lecithin, diacetyl tartrate ester of monoglyceride (DATEM), and sodium stearoyl lactylate (SSL). Emulsifiers have different functions in bread, e.g. lecithin behaves as a wetting agent, while DATEM and SSL act as dough strengtheners. Most bakeries use a blend of these functional ingredients.



The rate of staling in wheat bread can be quantified by the amount of starch molecule (amylopectin) recrystallization, as measured by DSC (differential scanning calorimetry). Adding soy decreases recrystallization and, thus, retards staling, as compared to a control without soy.

Lecithin

Lecithin, a primary emulsifier in egg yolks, also can be derived from rice and other grains. Soy-based lecithin, which contains phospholipids, is a by-product from the refining of crude soybean oil. The four main

components of soy lecithin include phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol, and phosphatidic acid. Soy-based lecithin has a more healthful image than some other emulsifiers.

With lecithin's hydrophobic and hydrophilic portions, it can simultaneously interact with both oil and water, making it an effective emulsifier. In addition, lecithin aids in machinability and shortening dispersion of baked goods. Various types of lecithin are available to bakers including fluid, deoiled (hydrophilic), chemically-modified (acetylated/hydroxylated), enzyme-modified (EM) and powdered versions of these.

Considerations for selecting lecithin are specific benefits, labeling requirements and handling procedures. Fluid lecithin is a viscous, syrupy, amber-colored liquid. Bakers prefer powdered lecithin. It is easy to incorporate with dry ingredients and is convenient to add to dry mixes.

Powdered, deoiled lecithin, commonly used in breads, has less flavor than fluid lecithin, is higher in phospholipid content, and is water dispersible. Standard fluid lecithin contains about 30% soybean oil, with deoiled lecithin containing 2% or less, says Karen Allen-Seabolt, associate scientist with Central Soya Co., Inc., Lecithin Group, Fort Wayne, Ind. Usage level is about 0.5 to 1.0% on a flour weight basis.

"We have different forms of lecithin to help increase volume and dough strengthening, and to extend shelf life," says Seabolt. "Deoiled, non-modified lecithin helps improve crumb structure and volume, but it doesn't help as much as enzyme—modified lecithin with shelf life for yeast-raised products."

Deoiled lecithin is more concentrated in phospholipids—the active, functional component of lecithin—than fluid forms, according to Bruce Sebree, Ph.D., manager of Emulsifier and Texturant Technology, ADM Research, Decatur, Ill. In most formulations, deoiled lecithin can replace standard fluid at two-thirds usage rate, he adds. EM lecithin performs similarly to monoglycerides because it will form a complex with starch more readily.

"In enzyme-modified lecithin, the middle-position fatty acid is removed from the phospholipid with a phospholipase enzyme," says Seabolt. "It is replaced with a hydroxyl group, making the molecule more polar, which increases its ability to complex with starch. EM lecithin is used mainly for yeast-raised baked goods to extend shelf life, but it also improves volume with its ability to act as a dough strengthening agent."

EM lecithin can replace mono-glycerides. Its use in bread is becoming more popular with bakeries today, adds Seabolt.

Alvarado Street Bakery uses several soy-based ingredients in its Sprouted Soy Crunch Bread, including: Organically-grown sprouted soybeans, toasted soy nuts, organically-grown whole soy flour, soy-based lecithin, as well as unsulphured molasses and organically-grown sprouted whole wheat. The bread is frozen, then shipped to mainstream supermarkets and health food stores coast to coast.

Website Resources

www.preparedfoods.com/archives/1997/1854.htm – PF article overview on science of emulsifiers and processing
www.scisoc.org/aacc/meeting/2001/abstracts/a01ma350.htm – AACC abstract on consumer acceptability of soy bread
www.eurekalert.org/pub_releases/2001-12/osum-oss120601.php – Press release on heart-healthy soy bread
www.frenchmeadow.com/ – French Meadow Bakery, Minneapolis, Minn.
www.alvaradostreetbakery.com/ – Alvarado Street Bakery, Rohnert Park, Calif.
www.preparedfoods.com/archives/2001/2001_4/0401soyfoodssoar.htm – PF article on soyfood
www.scisoc.org/aacc/meeting/2001/abstracts/a01ma375.htm – AACC abstract on soy's effect on bread properties during storage

OSU Researchers Formulate Tasty Soy Bread

Rather than relying on a nutritional bar or a beverage, researchers at Ohio State University (OSU) are hoping that consumers will consider an everyday food to get soy into their diets—bread.

One large slice or two slices (50g) of the bread contains 6.25g of soy protein per serving, which meets the soy protein health claim criteria.

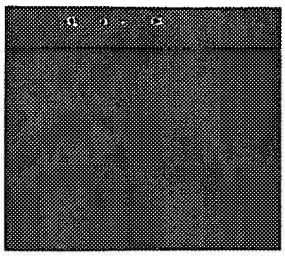
"I didn't start looking for health claims—I became interested in adding soy to bread formulations and comparing wheat bread and soy breads because staling seemed to be retarded with the addition of soy flour to wheat flour," says Yael Vodovotz, assistant professor of food science at Ohio State University and co-author of the book, Bread Staling. (CRC Press, 2000).

Vodovotz found adding soy to bread decreases amylopectin recrystallization significantly, increasing the soy bread's shelf life.

The bread contains flour made from hard red wheat and two soy-based ingredients—soy flour and soymilk powder. While loaf volume decreases with an increase in soy flour, soymilk helps increase the loaf volume and has a positive flavor impact, says Vodovotz. Adding mono- and di-glycerides—as well as some fat—helps increase the loaf volume by lubricating the dough system and increasing the flexibility of the intercellular structure. A dough strengthener, L-cysteine, boosts internal structure.

A consumer acceptability study by Cory Ballard, an OSU undergraduate and senior food technologist for Chef-Con, Delaware, Ohio, found that 70% of those who participated in in-store sensory tests preferred the flavor of soy bread to that of red wheat bread. "Kids really liked the soy bread because it's sweet," says Ballard.

In another study A.S. Colakoglu, an OSU student, investigated "The effect of soy on the thermal and mechanical properties of bread during storage." Differential Scanning Calorimeter (DSC) studies showed that the addition of soy flour (20%-40% substitution) to wheat flour decreased the amount of "freezable" water and amylopectin recrystallization, which can be interpreted to say that adding soy flour retards staling.



can be interpreted to say that adding soy flour retards staling.

OSU is licensing the formula to bakeries for sale in mainstream supermarkets. Researchers at the OSU medical school want to test the bread's cancer-control potential.

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Society in general has become overweight, and we immediately tend to jump on the bandwagon of condemning the consumption of foods categorized in the "fats" food group. Even the term "fats and oils" will sometimes send shivers of repulsion into the minds of those who maintain a rigid and uncompromising diet pattern, swearing off all foods from this necessary food group. "Fats" has somehow become the shunned four-letter word of dietary watchdogs. But in our quick dismissal of trimming fat from our diets, we have also tended to forget some of the necessary functions of what is known as "essential fats". The terminology is certainly apt; as a certain amount of fat in the diet is absolutely essential for our health. Learning about "good fat" and "bad fat" is crucial to assist in making healthy choices. Cutting out all fat in your diet is not a prudent or healthy choice.

From Cave Dwellers to Cond -Own rs

Civilization has certainly changed our lifestyles. Yet, the basic bodily needs have not changed since the beginning. Balance in life again is key. Our health

beginning. Balance in life again is key. Our health relies upon the basic needs of fresh air, clean water, sunshine, exercise and a common sense balance of proteins, carbohydrates and fats.

Our diet has changed significantly since our cave-dwelling ancestors inhabited the earth. Certainly the "good old days" are not always as good as one tends to conceive. Yet, studies of the hunter-gatherer lifestyle have shown innate understandings of the body's need for a balanced diet. This is where we gain even greater persuasion to understand the importance of essential fatty acids (EFA).

Due to lifestyle and dietary habits with fast-food and convenience foods, the general public has consumed a diet rich in fats. A common reaction then is to eliminate all or the majority of fat in the diet which is equally detrimental. The problem lies in the type of fat we ingest –too much saturated fat - known as the "bad fats" - the type that clogs arteries and raises cholesterol levels.

The diet of our ancestors included a good balance of essential fatty acids (EFA). Essential fatty acids (EFA) are grouped into two families, the omega-6 EFAs and the **omega-3** EFAs. The omega groups are considered the "good fats" or known as the polyunsaturated fats. The omega-6 fatty acids are found in corn, safflower, **sunflower**, canola and soybean oils. **Omega-3** EFAs are found in flaxseeds and flaxseed oil along with fish such as salmon, herring, trout, sardines and albacore tuna. Ground flaxseed and flaxseed oil provide a natural and concentrated level of **omega-3** EFAs, without concern for chemical contamination that may be a risk with fish consumption.

Finding Balance – The Alpha and the Omega

Understanding the difference between the omega-6 and the **omega-3** fatty acid is very important to know. It is more than just the difference in their numbers that should concern you.

Omega-6 fatty acids (found in vegetable oils with high proportions of linolenic acid) are best used by the body in a range of anywhere from a 4:1 to a 1:1 proportion with the **omega-3** fatty acids. We need both **omega-3** and omega-6 fatty acids. Yet, an excess of omega-6 fatty acids can have dire consequences. Many

scientists believe that a major reason for the high incidence of heart disease, hypertension, diabetes, obesity, and some forms of cancer is the extreme imbalance between our intake of omega-6 and **omega-3** fatty acids.

The parent compound in the **omega-3** fatty acid is called alpha-linolenic acid (ALA). It is this compound that serves as the "computer" or brain for the **omega-3** fatty acid in determining how it will best maximize the body's functioning.

Our ancestors evolved on a diet with a 1:1 ratio of omega-6 to **omega-3** fatty acids. Dietary changes over the last few centuries have changed this ratio anywhere from 20:1 to 25:1. This is clearly an equation for trouble, and today's chronic health problems obviously exemplify this concern.

One of the primary reasons we ingest too much of the omega-6 fatty acid groups in our diet is the mass use of vegetable oils. This practice is so far-reaching that practically every fried food and snack food available has been cooked in soybean, corn, **sunflower** or canola oil. These oils are usually processed by hydrogenation. This changes their molecular structure so they are basically good for frying foods at a high temperature and providing a lengthy shelf-life in the grocery store. Unfortunately, these molecular properties in the omega-6 fatty acids promote inflammation, blood clotting and tumor growth.

The **omega-3** fatty acids act entirely opposite. But, when the omega-6 fatty acids are disproportionately higher, the **omega-3** fatty acids cannot compete with the omega-6 activity. When in balance, they work in concert, making sure for every action there is a reaction, helping to maintain stability in the body.

When the omega-6 and **omega-3** fatty acids maintain a healthy balance; they effectively become clearinghouses or message centers to the rest of the body to:

- Alert the immune system to go into action
- Signal the blood vessels to either widen or narrow
- Tell blood platelets to clot or not by sticking together or separating
- Regulate inflammation

- Formulate neural networks for brain activity in learning, memory processes and mood regulation

Trouble is brewed when one fatty acid overpowers another. Clearly, the data shows we need to seriously increase **omega-3** fatty acids in our diets. **Omega-3** fatty acid deficiencies are increasingly prevalent with young children. A Purdue University study showed that children low in **omega-3** essential fatty acids are significantly more likely to be hyperactive, have learning disorders and to display behavioral problems.

In the general public, studies have linked **omega-3** deficiencies to chronic health problems of diabetes, cancer, arthritis, inflammatory diseases, depression, heart disease, hypertension, memory problems, weight gain and some allergies and skin conditions.

Researchers believe 60% of Americans are deficient in **omega-3** fatty acids and approximately 20% of those have so little that test methods would not be able to detect even a trace in their blood.

Changing the Scenario

We imagine you are now convinced of the need for adding **omega-3** fatty acids to your diet. Yet, probably wondering how to go about doing it and also wondering how much you need to add. As noted prior, the two major sources of **omega-3** fatty acids are fish such as salmon, trout, and albacore tuna and flaxseed. Due to high risk of chemical contamination in fish products, we recommend flaxseed and flaxseed products to boost your **omega-3** fatty acid consumption. Flaxseed is loaded with alpha-linolenic acid. Remember this is the "brain" of the **omega-3** fatty acid molecule and assists in maximizing the benefits of nutritious foods. Most foods have far less **omega-3** properties than what is found in flaxseed. In fact, it would take 25 cups of peanut butter to get the alpha-linolenic acid found in just _ cup of ground flaxseed. Imagine those calories, not to mention the stares you might get when going through the grocery line with a cart full of peanut butter! To gain further information about adding flaxseed to your diet you can link to the recipes and preparing flax sections. Helpful facts are also provided in the nutrition information, with accompanying dietary guidelines.

To order Omega3 Golden Flax online - click here.

NOTE: Information presented here does not replace seeking advice from your physician.

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Evening primrose oil: what's all the fuss about?

by Alyson Greenhalgh and Dr. Sara Kirk

Q What does evening primrose oil do?

A **Evening primrose oil is a nutritional supplement and a member of the essential fatty acid (EFA) group. There are two members of the group, the omega-3 and omega-6 fatty acids.**

Evening primrose oil is rich in omega-6 fatty acids and one of these, gamma linolenic acid (GLA), has certain medicinal properties that may act as an anti-inflammatory for conditions such as arthritis, eczema, high blood pressure or hypertension. Evening primrose oil is also believed to help alleviate cramps associated with pre-menstrual symptoms, though this has yet to be scientifically proven. Eating fatty fish such as tuna, mackerel, salmon and herring, and using safflower, sunflower and rapeseed oils in cooking is the first

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and rapeseed oils in cooking is the first step to increasing your intake of these acids. You can also consider taking a 2000-4000mg daily dose of an evening primrose oil supplement after consulting your doctor.

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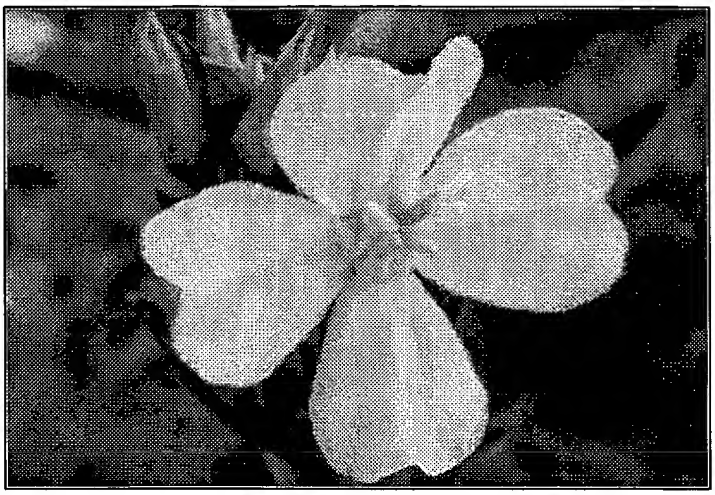
Evening Primrose Oil

Also indexed as: Black Currant Seed Oil, EPO, *Oenothera biennis*, Starflower



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What does it do? Evening primrose oil (EPO), black currant seed oil, and borage oil contain gamma linolenic acid (GLA), a fatty acid that the body converts to a hormone-like substance called prostaglandin E1 (PGE1). PGE1 has anti-inflammatory properties and may also act as a blood thinner and blood vessel dilator.

The anti-inflammatory properties of EPO have been studied in double-blind research with people suffering from rheumatoid arthritis. Some, but not all, studies have reported that EPO supplementation provides significant benefit to these people.[1]

GLA, the primary active ingredient in EPO, has anticancer activity in test tube studies[2] and in some,[3] but not all,[4] animal studies. Injecting GLA into tumors has caused regression of cancer in people in preliminary research.[5] Very preliminary evidence in people with cancer suggested "marked subjective improvement,"[6] though not all studies find GLA helpful.[7]

EPO has been reported to lower cholesterol levels in people in some,[8] but not all,[9] research.

Linoleic acid, a common fatty acid found in nuts and seeds and most vegetable oils (including EPO), should theoretically convert to PGE1. But many things can interfere with this conversion, including disease, the aging process, saturated fat, hydrogenated oils, blood sugar problems, and inadequate vitamin C, magnesium, zinc, and B vitamins. Supplements that provide GLA circumvent these conversion problems, leading to more predictable formation of PGE1.[10]

Where is it found? EPO is found primarily in supplements. The active ingredient, GLA, can also be found in black current seed oil and borage oil supplements.

Evening primrose oil has been used in connection with the following conditions (refer to the individual health concern for complete information):

Ranking	Health Concerns
Primary	Diabetes Eczema
Secondary	Alcohol withdrawal Fibrocystic breast disease Osteoporosis (in combination with fish oil) Phenylketonuria (if PUFA deficient) Premenstrual tension (PMT) Rheumatoid arthritis
Other	Atherosclerosis Attention deficit disorder Intermittent claudication Irritable bowel syndrome (IBS) Multiple sclerosis Raynaud's disease Scleroderma Sjogren's syndrome Tardive dyskinesia

Who is likely to be deficient? Those with premenstrual tension,[11] diabetes,[12] **scleroderma**,[13] **Sjogren's syndrome**,[14] tardive dyskinesia,[15] eczema,[16] and other skin conditions[17] can have a metabolic block that interferes with the body's ability to make GLA. In preliminary research, supplementation with EPO has helped people with these conditions.[18 19 20 21 22]

Though preliminary, double-blind evidence suggests that alcoholics may be deficient in GLA and that alcohol withdrawal may be facilitated with EPO supplementation.[23] Many people in Western societies may be at least partially GLA-deficient as a result of aging, glucose intolerance, dietary fat intake, and other problems. Individuals with deficiencies benefit from supplemental GLA intake from EPO, black currant seed oil, or borage oil.

How much is usually taken? Although many people may have inadequate levels of GLA, the optimal intake for this nutrient remains unknown. Researchers often use 3,000–6,000 mg of EPO per day, which provides approximately 270–540 mg of GLA.

Are there any side effects or interactions? EPO has been reported to exacerbate symptoms of temporal lobe epilepsy, which can sometimes be mistaken for schizophrenia.[24 25]

Other nutrients are needed by the body, along with EPO, to make PGE1. Consequently, some experts suggest that magnesium, zinc, vitamin C, niacin, and vitamin B6 should be taken along with EPO.

At the time of this writing, no evidence of drug interactions with evening primrose oil was found in the medical literature.

Within *Healthnotes Online,* information about the effects of a particular supplement or herb on a particular condition has been qualified in terms of the methodology or source of supporting data (for example: clinical, double blind, meta-analysis, or traditional use). For the convenience of the reader, the information in the table listing the supplements for particular conditions is also categorized. The criteria for the categorizations are: "Primary" indicates there are reliable and relatively consistent scientific data showing a health benefit. "Secondary" indicates there are conflicting, insufficient, or only preliminary studies suggesting a health benefit or that the health benefit is minimal. "Other" indicates that an herb is primarily supported by traditional use or that the herb or supplement has little scientific support and/or minimal proven health benefit.

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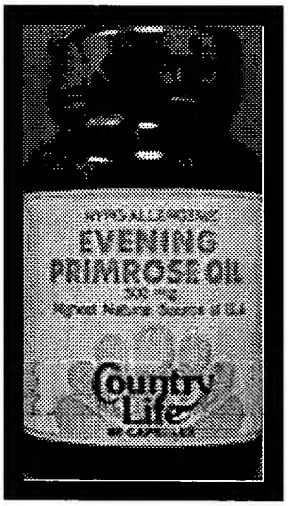
Evening Primrose Oil



Country® Life

Evening Primrose Oil

Highest Natural Source of GLA

500 mg

Gamma Linolenic Acid (GLA) and Linoleic Acid are Omega-6 fatty acids. they are responsible for the producton of the PGE-1 family of prostaglandins, the hormone substances which help maintiain the balance of many metabolic processes.

Essential fatty acids cannot be manufactured by the body and must be derived from food sources.

Country Life's Evening Primrose Oil is imported from Europe and is the finest quality available.

Suggested Use: Adults take 2 to 4 softgel capsules daily or more as directed by a health care professional.

Each Softgel Capsule Contains:	
Evening Primrose Oil	500 mg.
Providing 50 mg. of GLA (gamma-linolenic acid) and 350 mg. of Cis-Linoleic Acid	

No Yeast, Corn, Wheat, Soy, Milk, Salt, Sugar, Starch, Preservatives or Artificial Color.

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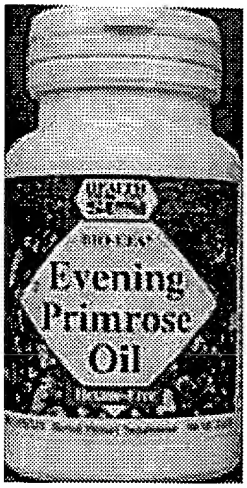

Health From The Sun

Evening Primrose Oil

Hexane-Free
500 mg. each

Health From The Sun™ Evening Primrose Oil is one of the best sources of the nutritionally important omega-6 fatty acids, Gamma-Linolenic Acid [GLA] and Cis-Linoleic Acid. The oil is extracted from the highest quality Evening Primrose seeds using the cold expeller-press method, without the chemical solvent hexane. It is a BIO-EFA® food oil, ensuring the most Bioavailable Essential Fatty Acids. Independently tested to guarantee purity and truth-in-labeling.

Health From The Sun's™ involvement with evening primrose oil goes back to its beginning as a product in the industry. We were the first company to introduce Evening Primrose Oil products to the United States!

Evening Primrose Oil, more commonly referred to as EPO, is by far the most popular source of Omega-6 EFAs, rich in both Linoleic Acid (LA) and Gamma Linolenic Acid (GLA). More research has been done on EPO than any other nutritional oil. This has contributed to its popularity, particularly in relation to PMS, cardiovascular disease, inflammation, and skin disorders.*

Each Capsule Contains:	
500 mg of 100% pure Evening Primrose Oil. providing:	
Cis-Linoleic Acid (omega-6)	370 mg.
Gamma-Linolenic Acid [GLA] (omega-6)	50 mg.
Oleic Acid (omega-9)	35 mg.

***This statement has not been evaluated by the Food & Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease. Health From The Sun™, "The Leader in Essential Fatty Acid Nutrition"**

Usage: Three to six capsules daily.

No sugar, starch, artificial preservatives or colors. Keep in a cool dry place. Do not use if safety seal is broken or missing.

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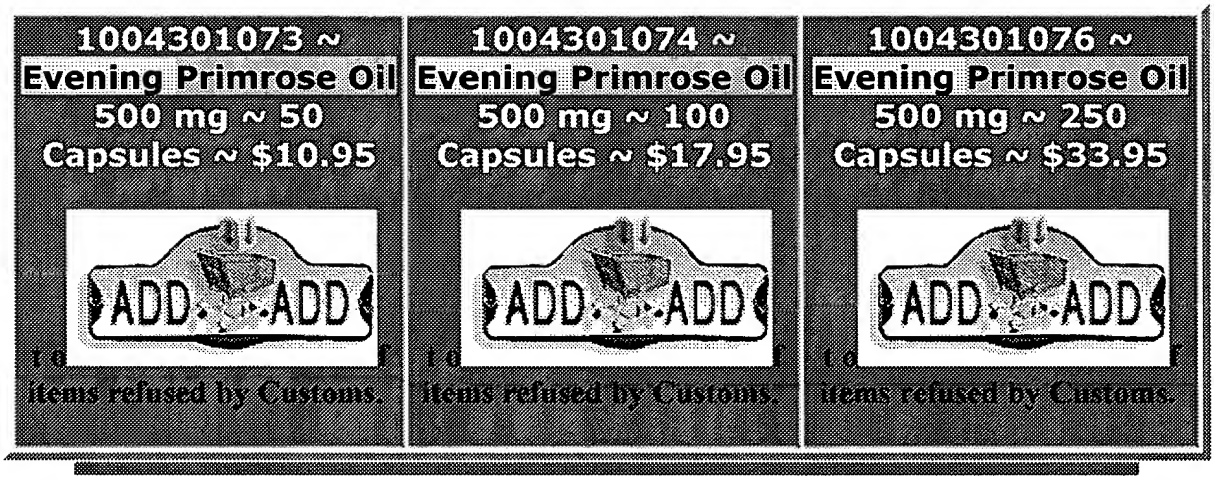

Health From The Sun

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popularity, particularly in relation to PMS, cardiovascular disease, inflammation, and skin disorders.*

Supplement Facts

Serving Size: 1 Capsule

	Amount Per Serving	% Daily Value
Calories	10	
Calories From Fat	10	
Total Fat	1.5 grams	2%*
Gamma-Linolenic Acid (GLA) (Omega-6)	130 mg	+
Linoleic Acid [GLA] (omega-6)	950 mg	+
Oleic Acid (omega-9)	80 mg.	+
* Percent Daily Values are based on a 2000 calorie diet + Daily Value Not Established		
Ingredients: Evening Primrose Seed Oil, Gelatin, Glycerin and Water		

***This statement has not been evaluated by the Food & Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease. Health From The Sun™, "The Leader in Essential Fatty Acid Nutrition"**

Two capsules of Health From The Sun™ Evening Primrose Deluxe supply more GLA than five standard 500 mg Evening Primrose Oil capsules.

Directions: Two or Three capsules daily.

No sugar, starch, artificial preservatives or colors. Keep in a cool dry place. Do not use if safety seal is broken or missing.

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1004301078 ~ Evening Primrose Oil 1,300 mg ~ 50 Capsules ~ $17.99

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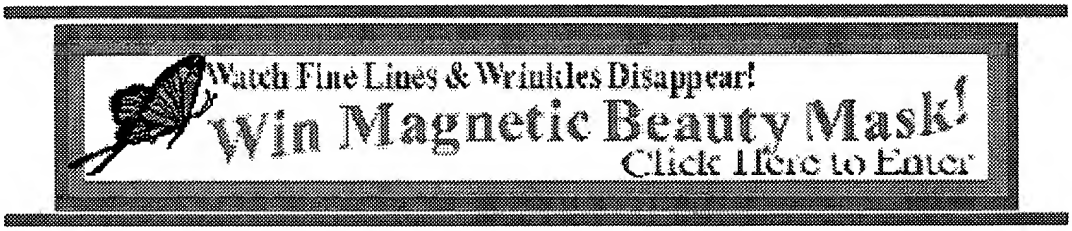

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BEV EPO is a rich source of Omega-6 fatty acids. These are considered essential fatty acids (EFA) du to their requirem nt f r prop r human growth and development. EPO is one of the richest sources of the Omega-6 fatty acid GLA (Gamma Linolenic Acid). BEV EPO supplies essential nutrition to help support body recomposition, immune system effectiveness, healthy skin, cardiovascular protection, and health and well being.

A QUICK HISTORY OF EPO

The evening primrose is a very unique plant. It reaches a height of eight feet tall and its flowers open only in the evening, fluorescing under the light of the moon. Its healing properties allow it to help strengthen the heart and the circulatory system. The history of the use of evening primrose is not as extensive as many herbal remedies. The Coahuilla Indians gathered leaves and caterpillars from it for food. Early English settlers of the Americas took evening primrose back to England where it was cultivated for its nut-flavored root. It is modern scientific research which has brought the health benefits of this plant to light. It has been discovered than an oil derived from the seeds of this plant is helpful in a wide range of health problems, including obesity, premenstrual syndrome, arthritis, multiple sclerosis, brittle nails, eczema, heart disease, high blood pressure, alcoholism and schizophrenia.

GAMMA LINOLENIC ACID

The key to effectiveness of evening primrose oil is the presence of gamma linolenic acid (GLA). GLA is an essential fatty acid. Essential fatty acids, like vitamins and some amino acids, are substances that the body needs to function properly but that it cannot produce. This means that GLA must come from dietary sources. But what is the function of GLA? GLA is the parent compound to omega-3 and omega-6 fatty acids, but it is even more important in the production of substances known as prostaglandins. Our bodies take linoleic acid (abundant in vegetables) and change it into GLA, then into diho-mogamma-linoleic acid to arachadonic acid. The arachadonic acid is then used to produce prostaglandins. Prostaglandins are hormone-like substances that regulate blood pressure and clotting.

WHY DO I NEED A SUPPLEMENT OF GLA?

By now you may be wondering, "if I eat vegetables that supply linoleic acid, why do I need a supplement of GLA?" Our diet, high in saturated fats and processed vegetable oils, inhibits the body's ability to change linoleic acid to GLA. This means that by supplementing the diet with GLA, the body can skip a step and more efficiently produce the prostaglandins. As it turns out, evening primrose is the only significant dietary source of GLA besides black currant oil and breast milk. That is why evening primrose oil can be so important to relieving the conditions already mentioned. One of the overall effects of evening primrose oil is that it works as an anticoagulant to lower blood pressure and strengthen the heart.

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BEV EPO
EVENING PRIMROSE OIL

DIRECTIONS: The generally recommended dosage of BEV EPO is one to three softgel capsules taken daily with meals. One (1) softgel capsul of BEV EPO provides 10 calories from 1000 mg Evening Primrose Oil which typically contains 700 mg Linoleic Acid and 90 mg Gamma Linolenic Acid.

Supplement Facts

Serving Size: 1 Softgel Capsule

Servings Per Container: 90

Amount Per Serving:

Calories: 10 **Calories from fat: 10**

		% Daily Value*
Total Fat	1 g	2%
Polyunsaturated Fat	1 g	**
Evening Primrose Oil	1000 mg	**
Linoleic Acid	700 mg	**
Gamma Linolenic Acid	90 mg	**

*Percent Daily Values are based on a 2000 calorie diet

**Daily Value Not Established

Other Ingredients: Gelatin and Glycerin

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Flaxseed – METABOLISM OF OMEGA-3 AND OMEGA-6 FATTY ACIDS

Fatty Acid Profile of Flaxseed

Flaxseed contains a mix of fatty acids. It is high in polyunsaturated fatty acids (73%), moderate in monounsaturated fatty acids (18%), and low in saturated fatty acids (9%). The saturated fat level of flaxseed is similar to that of canola. Flaxseed is a rich plant source of alpha-linolenic acid (ALA), an essential fatty acid in the human diet and the parent fatty acid of the omega-3 family, as shown in Figure 1. ALA is converted to two main long-chain fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), in a series of enzymatic reactions (below). ALA has been shown to modulate eicosanoid synthesis,[2] and its concentration in breast milk exceeds that of DHA, suggesting a particular requirement for ALA by infants.[3, 4]

Omega-6/Omega-3 Fatty Acid Ratio of Flaxseed

ALA comprises about 57% of the total fatty acids in flaxseed, whereas the omega-6 fatty acids comprise about 16%, giving an omega-6/omega-3 ratio of 0.3:1.[1] Because the typical Western diet is high in linoleic acid and low in omega-3 fatty acids, some experts recommend replacing omega-6 fatty acids with those from the omega-3 family. Consuming flaxseed or foods rich in ALA, such as omega-3 enriched eggs derived from hens fed flaxseed, increases omega-3 fatty acid intake. This improves the dietary omega-6/omega-3 ratio.[5]

Major Families of Unsaturated Fatty Acids

There are four major families of unsaturated fatty acids (see Table 1). Oleic acid is the most prevalent fatty acid in nature and can be synthesized in the body from dietary stearic acid (18:0).[6] Palmitoleic acid can be synthesized from dietary palmitic acid (16:0). Oleic and palmitoleic acids are not essential in human nutrition because they can be formed from dietary precursors.

Two fatty acids are required in the diets of humans because our bodies cannot manufacture them from dietary precursors: Alpha-linolenic acid, the parent compound of the omega-3 fatty acid family, and linoleic acid, the parent compound of the omega-6 family. Arachidonic acid, a metabolite of linoleic acid, is considered an essential fatty acid (EFA) only when a linoleic acid deficiency exists.[7]

Desaturation and elongation. Alpha-linolenic acid and linoleic acid are converted to their respective metabolites by a series of alternating desaturations and elongations. The desaturations add a double bond by removing hydrogen, while the elongations add two carbon atoms.

TABLE 1

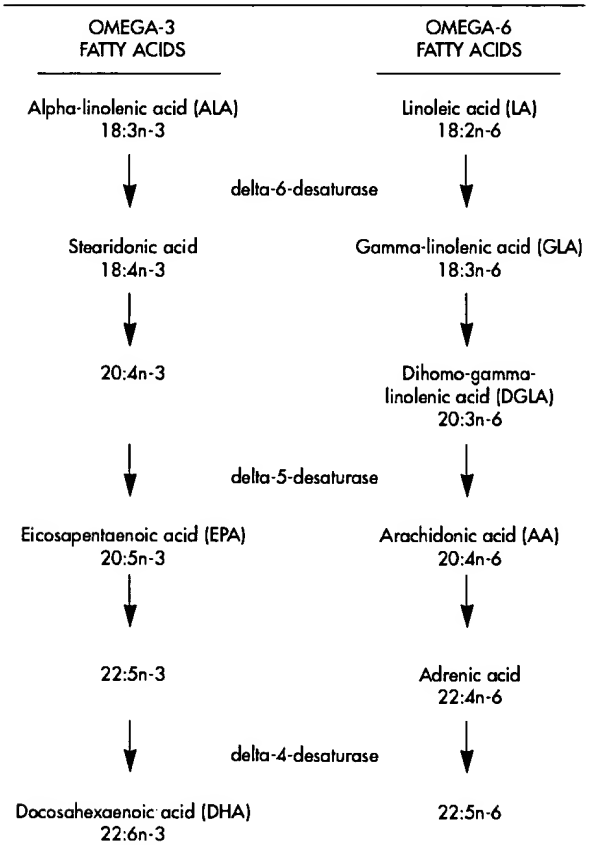
Nomenclature of Major Families of Unsaturated Fatty Acids[a]

Parent Compound	Number of Double Bonds	Family Name[b]	Structural Abbreviations[c]
Oleic acid	one	Omega-9 (ω-9)	18:1n-9 or 18:1ω-9
Palmitoleic acid	one	Omega-7 (ω-7)	16:1n-7 or 16:1ω-7
Linoleic acid	two	Omega-6 (ω-6)	18:2n-6 or 18:2ω-6
Alpha-linolenic acid[d]	three	Omega-3 (ω-3)	18:3n-3 or 18:3ω-3

[a] Adapted from Vaisey-Genser M. In: *Flaxseed: Health, Nutrition and Functionality.* Winnipeg, MB: Flax Council of Canada, 1994, p. 11.
[b] The family name denotes the position of the first double bond as the number of carbon atoms from the methyl end of the fatty acid chain.
[c] Number of carbon atoms: number of double bonds (fatty acid family).
[d] Also designated α-linolenic acid. Alpha-linolenic acid is distinct from gamma-linolenic acid (γ-linolenic acid (18:3n-6)), which is an intermediate in the omega-6 metabolic pathway and is a major component of evening primrose, borage and black currant oils.

FIGURE 1

Metabolic Pathways of the Omega-3 and Omega-6 Fatty Acids



Only the names of major fatty acids are shown in this figure.

The first step in the metabolism of both EFA families is desaturation, catalysed by delta-6-desaturase. This step is followed by elongation, then desaturation (catalysed by delta-5-desaturase), then elongation and, finally, desaturation (catalysed by delta-4-desaturase). The desaturation steps tend to be slow, while the elongation steps are rapid. Thus, the tissue concentrations of gamma-linolenic acid (GLA) (18:3n-6) and stearidonic acid (18:4n-3) tend to be low, because they are formed slowly by desaturation and then quickly elongated to other metabolites.[8, 9]

Competition between families. Mammals cannot interconvert the omega-3 and omega-6 fatty acids. Furthermore, their metabolism requires the same desaturation enzymes, resulting in competition between the two families. An excess of one family of fatty acids can interfere with the metabolism of the other, reducing their incorporation into tissue lipids and altering their biological effects.[8, 10]

Metabolism of Alpha-Linolenic Acid (ALA)

Dietary ALA appears to have two metabolic fates. It can be desaturated and elongated to its long-chain metabolites or it can undergo ß-oxidation. Although studies of ALA ß-oxidation in humans have not been conducted, studies in animals suggest that the metabolism of ALA by ß-oxidation may contribute significantly to energy production.[11] Additional research is needed to clarify the relative importance of these metabolic pathways.

Conversion of ALA to EPA and DHA. About 15% of ALA is converted to EPA and about 5% is converted to DHA in a process that is somewhat slow in humans.[5, 11] Conversion of ALA to its long-chain metabolites is affected by various dietary factors. A diet rich in linoleic acid, for example, has been shown to reduce ALA conversion by as much as 40%,[10] and a high maternal intake of linoleic acid lowers EPA and DHA levels in umbilical plasma, suggesting reduced ALA conversion and availability of omega-3 fatty acids to the developing fetus.[12] Saturated and *trans* fatty acids also interfere with ALA desaturation and elongation,[13, 14] and in rats, ethanol inhalation results in a significant loss of liver DHA, indicating reduced ALA conversion.[15]

DHA can be converted back into EPA in a reaction called retroconversion. This is believed to be a minor metabolic pathway in humans.[16]

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